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REVIEW ARTICLE

Review of the investigation and surgical management of resectable ampullary adenocarcinoma

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Abstract

Background: Ampullary adenocarcinoma is considered to have a better prognosis than either pancreatic or bile duct adenocarcinoma. Pancreaticoduodenectomy is associated with significant mortality and morbidity. Some recent publications have advocated the use of endoscopic papillectomy for the treatment of early ampullary adenocarcinoma. This article reviews investigations and surgical treatment options of ampullary tumours.

Methods: A systematic review of English-language articles was carried out using an electronic search of the Ovid MEDLINE (from 1996 onwards), PubMed and Cochrane Database of Systematic Reviews databases to identify studies related to the investigation and management of ampullary tumours.

Results: Distinguishing between ampullary adenoma and adenocarcinoma is challenging given the inaccuracy of endoscopic biopsy, for which high false negative rates of 25–50% have been reported. Endoscopic ultrasound is the most accurate method for local staging of ampullary lesions, but distinguishing between T1 and T2 adenocarcinomas is difficult. Lymph node metastasis occurs early in the disease process; it is lowest for T1 tumours, but the risk is still high at 8–45%. Case reports of successful endoscopic resection and transduodenal ampullectomy of T1 adenocarcinomas have been published, but their duration of follow-up is limited.

Conclusions: Optimal staging should be used to distinguish between ampullary adenoma and adenocarcinoma. Pancreaticoduodenectomy remains the treatment of choice for all ampullary adenocarcinomas.

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Introduction

Ampullary malignancies are rare tumours with a reported incidence of fewer than one case per 100 000 population.[1] Although these malignancies account for <5% of pancreatic and other biliary malignancies, the rate of ampullary adenocarcinoma in the USA increased annually from 1973 to 2005.[1] The incidence of ampullary malignancy increases with advancing age, most notably after the age of 50 years; according to the Surveillance, Epidemiology and End Results (SEER) database in the USA, the median age at diagnosis is 65 years.[1,2] It has been proposed that ampullary adenocarcinoma develops from pre-cancerous adenomas via an adenoma–carcinoma sequence, similar to that seen in colorectal cancer.[3–5] Significantly, up to 50% of ampullary villous adenomas contain a focus of adenocarcinoma at the time of diagnosis.[6,7] Studying patients with familial adenomatous polyposis (FAP) has provided some insight into the natural history of ampullary adenoma. Duodenal adenomas occur in up to 95% of FAP adults, with most occurring in the periampullary region.[8] The rate of progression to adenocarcinoma is very slow and it is estimated that only 5% of ampullary adenomas progress to adenocarcinoma.[9]

Because of their unique location, ampullary malignancies often present early in the course of the disease with obstructive jaundice.[10] Early lymph node metastasis is common, but patient presentation usually occurs prior to distant organ metastasis.[11] In a 10-year study by Tien *et al.*,[11] only eight (5%) of 163 patients with ampullary adenocarcinoma had liver metastases at the time of presentation. However, diagnosis at an advanced age renders many patients unsuitable for surgery; data from the SEER database show

that only 40% of patients diagnosed with ampullary adenocarcinoma undergo resection.[2]

Given the advanced age of presentation with ampullary adenocarcinoma and the significant mortality and morbidity associated with pancreaticoduodenectomy, recent attention has focused on alternative methods of treatment.[12] Case reports of the successful treatment of ampullary adenocarcinomas by transduodenal ampullectomy and endoscopic papillectomy (EP) have been published.[13,14] The aim of this review is to summarize the literature regarding investigations into surgical treatment options for resectable ampullary malignancies.

Materials and methods

Evidence acquisition

Studies reporting on the investigations and treatment of ampullary tumours were sought. Literature searches using Ovid MEDLINE (from 1996), PubMed and the Cochrane Database of Systematic Reviews databases were performed. Boolean logic methods were used to combine medical subject heading (MeSH) terms to identify the articles referenced in this paper. The full strategy for the electronic search of the PubMed database is outlined in Appendix 1. One reviewer (JA) selected articles based on titles and abstract content. In cases of doubt, articles were reviewed in their entirety. Reference lists of relevant publications were hand-searched for additional studies missed by the search strategy. The last date on which a literature search was undertaken was 4 August 2012.

Study inclusion criteria

The study methodology adhered to the PRISMA (*p*referred *r*eporting *i*tems for *s*ystematic reviews and *m*eta-*a*nalyses) recommendations for improving the standard of review articles.[15] Only studies published in the English language from January 2000 onwards were included. When multiple studies describing the same patient population were identified, the most recent publication was used.

Studies on diagnostic tests were required to report at least one of the following outcomes: sensitivity; specificity; positive and negative predictive values, and tumour and node staging. Studies describing clinical outcomes were required to report one or more of the following: morbidity and mortality; time to recurrence, and time to death.

Data extraction and quality control

The literature retrieval and screening of relevant studies was performed by JA. The title and abstract of each article were appraised and, if they gave any suggestion of providing relevant data, the full text was retrieved.

Statistical analysis

Statistical analysis was not possible as the data could not be pooled. The included studies displayed varied and specific areas of interest (e.g. diagnostic tools, endoscopic intervention, surgery) and not all modalities were available to all patients in each study. There was significant heterogeneity in both study design and the quality of the included studies.

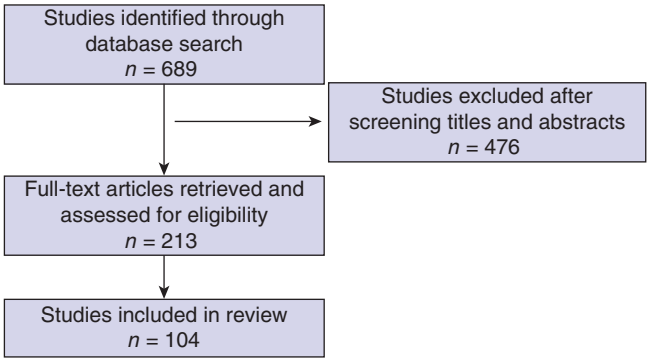

Figure 1 Modified PRISMA (*p*referred *r*eporting *i*tems for *s*ystematic reviews and *m*eta-*a*nalyses) flow diagram showing study methodology

Results

The initial search using the search strategy outlined earlier identified a total of 689 studies (Fig. 1). The titles and abstracts of the selected studies were appraised. Full texts were retrieved for a total of 213 articles, of which 104 were found to meet the inclusion criteria for this review. The most common reason for exclusion was reporting on ampullary adenomas but not adenocarcinomas. In addition, studies that did not distinguish between ampullary and periampullary adenocarcinomas in their data were excluded.

Investigations and clinical staging

The presence of an ampullary tumour can be confirmed using different diagnostic modalities. Endoscopy, endoscopic ultrasound (EUS), abdominal US, computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET) can all be employed to help diagnose and stage these tumours.[13,16] The anatomical location of the ampulla and small size of ampullary tumours renders the detection of a lesion mass difficult, although indirect signs of bile and pancreatic duct dilatation are easier to detect.[17,18] Furthermore, distinguishing between benign and malignant tumours is problematic given the inaccuracy of the investigations.[16,17,19] An abdominal US is inaccurate at detecting ampullary tumours: reported detection rates range from 12% to 27%.[16,20,21] An elevated carbohydrate antigen 19-9 (CA 19-9) level may help to guide the diagnosis towards an ampullary adenocarcinoma, although 37% of patients with adenocarcinoma have been found to have normal CA 19-9 levels.[10]

Endoscopic characteristics can help differentiate between benign and malignant tumours. Ampullary adenomas are typically discoloured lobular lesions, whereas firmness, ulceration and

Table 1 Accuracy of computed tomography and magnetic resonance imaging in staging ampullary tumours

Authors	*n*	Tumour detection			Correct staging	
		n	Sensitivity	Specificity	T-stage	N-stage
Computed tomography						
Skordilis *et al*. 2002[20]	20	4				11/17
Maluf-Filho *et al*. 2004[65]	10		30%	98%		7/10
Chang *et al*. 2007[17]	24	24	92%[a]	92%[a]		
Artifon *et al*. 2009[32]	27				14/27	15/27
Chen *et al*. 2009[21]	28	8			6/23	10/23
Tien *et al*. 2009[11]	54	8	15%	100%		
Lee *et al*. 2011[66]	20		48%	86%		
Magnetic resonance imaging						
Kim *et al*. 2007[33]	25	24			14/15	
Chen *et al*. 2009[21]	16	13			7/13	10/13
Chung *et al*. 2011[38]	19	17	84%	86%		

[a]Sensitivity and specificity for tumours of >12.3 mm.

duodenal wall adherence are present in malignancies with local invasion.[13] Narrowband imaging endoscopy may also help to diagnose ampullary malignancies, although diagnostic criteria have yet to be established.[22]

Endoscopic biopsies of ampullary adenocarcinomas have poor diagnostic accuracy; high false negative rates range between 25% and 50%.[19,23,24] Biopsy accuracy is also reported to decrease with repeated biopsies.[11] In addition, endoscopic biopsy often underestimates the actual pathology and an endoscopic diagnosis of high-grade dysplasia is associated with an underlying adenocarcinoma on definitive pathology in 50–100% of patients.[25,26] Endoscopic US-guided biopsy can be used to help increase diagnostic accuracy.[27] In a small 35-patient study, EUS-guided biopsy displayed diagnostic accuracy close to 90% in assessing ampullary tumours.[27]

Although up to 50% of ampullary villous adenomas contain a focus of adenocarcinoma at the time of diagnosis, ampullary tumour size has not been shown to be a factor in differentiating between benign and malignant tumours.[6,7,10] Winter *et al.*[10] studied 450 patients with ampullary tumours and reported that the median adenocarcinoma size (2.0 cm) was smaller than the median adenoma size (2.9 cm). However, Tien *et al.*[11] suggested that tumour size is important in predicting malignancy and documented that 28% of adenocarcinomas but only 12% of adenomas were >3.0 cm in size.

The use of 18-fluorodeoxyglucose (18-FDG) PET for detecting periampullary neoplasms and for differentiating between benign and malignant tumours has been studied.[28–30] Sperti *et al.*[28] described 11 of 14 ampullary tumours which showed 18-FDG focal uptake, but found a high false positive rate as four of five adenomas also showed focal uptake of the tracer. Similarly, Wakabayashi *et al.*[29] concluded that although PET was superior to CT in diagnosing malignant disease in patients with biliary strictures, false positive results were obtained in patients with benign inflammatory conditions.

Accurate pretreatment staging of an ampullary malignancy is important, especially given the suggestion that adenocarcinoma confined to the mucosa can be treated endoscopically.[31] Table 1 outlines the accuracy of CT in staging ampullary tumours. Technological advances in CT have resulted in enhanced image resolution and detection rates have subsequently improved.[16,20] In a study by Skordilis *et al.*[20] published in 2002, only four of 20 ampullary tumours were detected using a 10-mm slice thickness in CT. Artifon *et al.*[32] used a 5-mm slice thickness and image reconstruction in a series in which all 27 ampullary tumours were detected. However, despite these improvements, the accuracy of CT for tumour (T) (26% or 52%) and node (N) (43–65%) staging remains low (Table 1). Computed tomography more frequently understages than overstages ampullary tumours; however, its use in staging should be routine given its ability to detect distant metastatic disease.[32]

Chen *et al.*[21] have suggested that MRI and EUS are superior to CT and conventional US for T- and N-staging. However, both MRI and EUS are limited in their ability to distinguish between early malignant adenocarcinoma and benign adenoma.[21] Eight studies, including those by Chen *et al.*[21] and Kim *et al.*,[33] which reported on overall T- and N-staging accuracy, have reported accuracies of MRI in identifying an ampullary tumour ranging between 4% and 81% (Table 1).[16,34–38]

Of the diagnostic modalities, EUS represents that which has been most studied; its overall accuracy in correctly diagnosing T-stage is reported to range from 63% to 82% (Table 2). Accuracies reported for correct N-staging range from 60% to 81% (Table 2). Critically, success in differentiating between T1 and T2 tumours is variable, as acknowledged by Ito *et al.*[13] in their review of this subject. The addition of intraductal US, or

Table 2 Accuracy of endoscopic ultrasound in staging ampullary tumours

Authors	*n*	Tumour detected	Correct staging			
			T1	T2	Overall T	N-stage
Skordilis *et al*. 2002[20]	20	20			14/17	12/17
Maluf-Filho *et al*. 2004[65]	10	9			5/8	6/10
Ito *et al*. 2007[67]	40	38	13/21	5/11	25/40	
Artifon *et al*. 2009[32]	27	27		11/13	20/27	22/27
Chen *et al*. 2009[21]	41	40	4/7	12/17	24/33	22/33
Imazu *et al*. 2010[39]	4	4	0/1		3/4	
Manta 2010[37]	24	24			15/24	

contrast-enhanced harmonic imaging, to EUS may improve its diagnostic accuracy.[13,39,40]

The role of staging laparoscopy has been questioned, given the high resectability rate using pancreaticoduodenectomy in early disease presentation without distant metastases.[41,42] Vollmer *et al*.[42] showed that diagnostic laparoscopy and laparoscopic US did not alter management in 22 patients with ampullary tumours. Brooks *et al*.[41] performed diagnostic laparoscopy in 67 patients with ampullary tumours, in six (9%) of whom laparoscopy detected distant metastases that had not been previously detected by CT. Similarly, Tilleman *et al*.[43] did not recommend staging laparoscopy when they detected distant metastatic disease in 6% of patients undergoing laparotomy for ampullary tumours, but performed a palliative bypass in these patients.

Treatment of early ampullary adenocarcinoma and lymph node metastasis

Pancreaticoduodenectomy, or a modification of it, is the mainstay of surgical treatment for ampullary malignancies.[10] Other surgical procedures that have been employed include transduodenal ampullectomy, pancreas-sparing segmental duodenectomy, pancreas head resection with segmental duodenectomy, and complete resection of the extrahepatic portion of the common bile duct and the ampulla.[23,44,45]

Benign ampullary adenomas have historically been treated surgically until the 1990s when EP gained popularity. EP was described in 1987 by van Stolk and with improved endoscopic techniques and pre-operative investigations this has now become the treatment of choice for most adenomas.[46,47] Ampullary tumours have been observed to spread along the mucosa of the pancreatic and biliary ducts prior to any muscular invasion.[48,49] This ductal extension has been noted in both benign and malignant tumours and is a critical factor in the consideration of local treatment options.[48] Bohnacker *et al*.[50] reported successful EP for benign tumours with up to 1.0 cm of intraductal growth.

Given the success of endoscopic resection in the treatment of benign ampullary adenoma, attention has turned to the role of EP in early ampullary adenocarcinoma. For EP to be curative, accurate tumour staging is essential and the risk for lymph node metastasis must be considered.[12] The risk for lymph node metastasis significantly increases with tumour depth, degree of differentiation and microvascular invasion.[10] Other tumour-related factors, including tumour size, an ulcerative morphology and perineural invasion are also associated with an increased risk for lymph node metastasis.[10,51] Table 3 displays pooled data from several studies addressing the risk for lymph node metastasis based on individual tumour characteristics.[10,12,23,31,48,52,53]

Table 3 Risk for lymph node metastasis based on primary tumour characteristics

Primary tumour size	T-stage	Differentiation
<1.0 cm: 7–12%	T1: 8–45%	Good: 19–25%
1.0–2.0 cm: 26–57%	T2: 23–51%	Moderate: 39–42%
2.0–3.0 cm: 39–47%	T3: 38–72%	Poor: 44–53%
>3.0 cm: 33%	T4: 57–78%	

The roles of local resection, EP and transduodenal ampullectomy are controversial and attention has primarily focused on T1 disease, in which the risk for lymph node metastasis is lowest. As Table 3 shows, there is a high risk for lymph node metastasis even in the early stage of the disease process. Table 4 addresses this risk specifically in T1 disease. In a series reported by the Johns Hopkins Medical Institute, only 9% of surgically treated ampullary adenocarcinomas were identified as T1 tumours.[10] In addition, it is worth noting that over 50% of patients undergoing pancreaticoduodenectomy for ampullary adenocarcinoma display lymph node metastases.[10,51] The posterior pancreaticoduodenal lymph node group is the most commonly involved.[54–56]

Given the high risk for lymph node metastasis, Winter *et al*.[10] and Y-S Yoon *et al*.[48] concluded that local resection should not be considered as an alternative to pancreaticoduodenectomy. By contrast, SM Yoon *et al*.,[31] Woo *et al*.[12] and Ito *et al*.[13] have suggested the risk for lymph node metastasis is negligible provided strict criteria are met. In a retrospective study by Woo *et al*.[12] of 57 T1 tumours treated by pancreaticoduodenectomy no lymph node metastases were seen in well differentiated focal tumours less than 2 cm in size which displayed no angiolymphatic invasion. Thirteen (6%) patients met this criteria in their retrospective review of 216

patients with ampullary adenocarcinoma over a fifteen year period.[12] Endoscopic papillectomy has been used to treat T1 adenocarcinoma; published case reports and series are displayed in Table 5. These data show that T1 adenocarcinoma has a very low recurrence rate when treated with EP. However, these studies are limited by small numbers of patients in each report and short-term follow-up. The American Society for Gastrointestinal Endoscopy guidelines, published in 2006, suggest that EP should not be performed for ampullary adenocarcinoma.[46] The information shown in Table 5 does not give reason to change this recommendation.

Table 4 Lymph node metastasis in T1 ampullary adenocarcinoma

Authors	Patients with T1 disease, *n*	Patients with lymph node metastasis, *n*
Yoshida *et al*. 2000[68]	9	0
Todoroki *et al*. 2003[69]	9	1
de Castro *et al*. 2004[24]	36	10
Yoon *et al*. 2005[48]	67	6
Kobayashi *et al*. 2006[60]	3	1
Lee *et al*. 2006[70]	30	3 (17[a])
Terasawa *et al*. 2006[71]	15	3
Barauskas *et al*. 2007[72]	4	0
Yoon *et al*. 2007[31]	52	4
Bogoevski *et al*. 2008[73]	7	0 (6[b])
Winter *et al*. 2009[10]	25	7
Woo *et al*. 2009[12]	57	5
Hornick *et al*. 2011[74]	11	5
Lee *et al*. 2011[55]	10	2

[a]Microlymphovascular invasion present in 17 patients.
[b]Nodal microinvolvement present in six patients.

Transduodenal ampullectomy can be performed with lower morbidity and mortality than the more radical pancreaticoduodenectomy.[11] This procedure should be considered for adenomas that are not amenable to EP and in which preoperative biopsy and thorough preoperative investigations do not suggest malignancy. Tien *et al*.[11] performed 20 transduodenal ampullectomies on 'benign' lesions of <3.0 cm in size and utilized intraoperative frozen-section biopsy to confirm the benign nature of the lesion and to ensure clear bile and pancreatic duct margins. Final histology confirmed adenocarcinoma in only two (10%) of the lesions, both of which were subsequently treated with pancreaticoduodenectomy.

The role of transduodenal ampullectomy in the treatment of adenocarcinoma has been questioned because of the reported low negative margin (R0) resection rate and high disease recurrence rate.[24] R0 resection rates as low as 40% and recurrence rates of up to 100% are of concern.[23,24,53,57,58] Significantly, these earlier studies did not report T-staging. Subsequent studies have focused on transduodenal ampullectomy in T1 adenocarcinomas (Table 6) and have shown a low recurrence rate provided that an R0 resection can be achieved in patients without lymph node metastases.

Beger *et al*.[23] performed 10 transduodenal ampullectomies with local lymph node dissection and achieved longterm success in four patients. However, all of the six patients in whom R1 resection was achieved had recurrent disease within 3 years. Significantly, following transduodenal ampullectomy, disease recurrence occurred locally and with distant liver metastases and was not amenable to further surgery.[59] Frozen-section biopsy at the time of operation should be used to confirm clear resection margins and lymph node status.[14] Proceeding to a pancreaticoduodenectomy if positive margins or malignant lymph nodes are present is recommended.[14] In patients with confirmed ampullary adenocarcinoma

Table 5 Endoscopic papillectomy for T1 ampullary adenocarcinoma

Authors	*n*	Tumour	Recurrence, *n*	Follow-up, months
Park *et al*. 2000[75]	1	T1	1	28
Jung *et al*. 2001[19]	1	T1	0	2
Tokunga *et al*. 2002[76]	1	Well differentiated	0	48
Ito *et al*. 2004[77]	1	T1 mucosal	0	7
Neeves *et al*. 2006[78]	1	T1 mucosal	0	24
Katsinelos *et al*. 2007[79]	1	T1 mucosal	0	7
		Well differentiated		
Yoon *et al*. 2007[31]	6	T1 mucosal	0	32 mean
Fukushima *et al*. 2009[80]	1	T1 mucosal	0	6
Harano *et al*. 2010[81]	2	T1 mucosal	0	17 and 172
Yamashita *et al*. 2010[82]	1	T1 mucosal	0	23
		Well differentiated		
Ito *et al*. 2011[77a]	12	T1	4/28	15–41
Salmi *et al*. 2011[83]	2	T1 mucosal	0	42 mean

[a]This study included an additional 16 patients with adenomas and did not differentiate between malignancy and adenoma; all recurrences were successfully treated with argon plasma coagulation.

Table 6 Transduodenal ampullectomy for T1 ampullary adenocarcinoma

Authors	*n*	Disease recurrence	Follow-up, months
Beger *et al*. 1999[23]	10	R0: 0/4	60 for three patients
		R1: 6/6	36
Posner *et al*. 2000[84]	2	0	61 and 11
Nikfarjam *et al*. 2001[85]	4	0	20 median
Bohra *et al*. 2002[86]	1	1	10
Fraguela Marina 2003[87]	4	0	13 mean
Dixon *et al*. 2005[59]	6	2	33 mean
Meneghetti *et al*. 2005[26]	5	1	–
Genc *et al*. 2007[88]	1	1	15
Park *et al*. 2007[14]	8	N0: 0/5	46 mean
		N1: 3/3 deceased	
Shiba *et al*. 2009[89]	1	0	10
Honda *et al*. 2010[90]	2	0	1

who are deemed too frail to undergo pancreaticoduodenectomy, ampullectomy may be considered, although the low R0 resection rate and high risk for recurrence must be acknowledged.[60]

In a series reported by Park *et al*.,[14] three of eight patients with T1 adenocarcinoma displayed lymph node metastases at the time of transduodenal ampullectomy and none survived longterm. This outcome highlights not only the high rate of lymph node metastasis in T1 disease, but also the difficulty of determining preoperatively which patients have local disease only. Again, studies addressing the role of transduodenal ampullectomy in T1 adenocarcinoma are limited by small patient samples.

Pancreaticoduodenectomy remains the treatment of choice in ampullary adenocarcinoma and can achieve an R0 resection rate of >95%.[10] Improvements in surgical technique and perioperative care have reduced morbidity and 30-day mortality subsequent to this procedure.[61] The largest published single-centre series of pancreaticoduodenectomies for ampullary adenoma and adenocarcinoma (n = 435) reported postoperative mortality of 2% and morbidity of 52% (Table 7).[10]

Table 7 Morbidity and mortality in pancreaticoduodenectomy for ampullary adenocarcinoma in studies with sample sizes of >50

Authors	Patients, *n*	Morbidity	Mortality
Duffy *et al*. 2003[91]	55	49%	0%
Todoroki *et al*. 2003[69]	56	9%	0%
de Castro *et al*. 2004[24]	120	52%	5%
Brown *et al*. 2005[92]	51	47%	2%
Giorgio *et al*. 2005[93]	64	34%	9%
Roggin *et al*. 2005[53]	99	67%	5%
Yoon *et al*. 2005[48]	201	34%	1%
Balachandran *et al*. 2006[94]	113	48%	8%
Hsu *et al*. 2006[51]	135	59%	3%
Qiao *et al*. 2007[95]	124	40%	10%
Falconi *et al*. 2008[96]	96	58%	4%
Yao *et al*. 2008[97]	67	21%	0%
Berberat *et al*. 2009[64]	75	37%	1%
Tien *et al*. 2009[11]	64	39%	3%
Winter *et al*. 2009[10]	435[a]	52%	2%
Yeh *et al*. 2010[98]	147	49%	4%
Choi *et al*. 2011[99]	68	45%	3%
Showalter *et al*. 2011[100]	61	8%	–

[a]Includes 90 pancreaticoduodenectomies for ampullary adenomas.

Prognosis

Ampullary adenocarcinoma is considered to have a better prognosis than either pancreatic or bile duct adenocarcinoma, with larger series reporting 5-year survival rates of 37–68%.[10,12,24] This can be partially explained by earlier diagnosis and the less frequent occurrence of adverse pathological factors.[62] There is still, however, a high risk for disease relapse and the most important prognostic indicators for recurrent disease are the presence of lymph node metastasis and pancreatic invasion (T3).[51] Lymph node-positive disease is associated with median survival that is less than a third of that in lymph node-negative disease (23 months versus 79 months).[10] The number of positive nodes predicts survival. In a study by Sakata *et al*.,[63] no patients with four or more positive nodes survived 5 years. Pancreatic invasion is a poor prognostic indicator. Berberat *et al*.[64] reported a series in which no patient with T3 or T4 disease survived 5 years.

Table 8 depicts prognosis following pancreaticoduodenectomy for T1 ampullary adenocarcinoma. The largest study to address this issue included 61 patients and reported 5-year survival of 83%, although it did not differentiate between node-negative and node-positive disease.[48] Any longterm results of alternative treatment methods for T1 ampullary adenocarcinoma should be compared against this standard.

Table 8 Pancreaticoduodenectomy for T1 ampullary adenocarcinoma

Authors	Patients, *n*	Overall 5-year survival in T1 disease
Todoroki *et al*. 2003[69]	9	100%
de Castro *et al*. 2004[24]	36	68%
Giorgio *et al*. 2005[93]	17	86%
Yoon *et al*. 2005[48]	61	83%
Hsu *et al*. 2006[51]	17	84%
Terasawa *et al*. 2006[71]	12	83% (lymph node –)[b]
Qiao *et al*. 2007[95]	13	70%[a]
Carter *et al*. 2008[101]	27	60%[a]
Sierzega *et al*. 2009[102]	12	100%
Uchida *et al*. 2009[103]	14	100%
Woo *et al*. 2009[12]	57	87%
Lee *et al*. 2010[104]	9	67%
Choi *et al*. 2011[99]	12	82.5%
Hornick *et al*. 2011[74]	11	75% (lymph node –)
		25% (lymph node +)

[a]Figures extrapolated from graphs.

Conclusions

Optimal staging should be used to distinguish between ampullary adenoma and adenocarcinoma. Endoscopic biopsy has a high false negative rate and EUS-guided biopsy provides a more accurate assessment. Endoscopic US is superior to MRI and CT for local staging. However, the accurate differentiation of T1 and T2 adenocarcinomas is difficult. Ampullary adenocarcinoma metastasizes to local lymph nodes early in the course of the disease. This risk is lowest in T1 tumours, but remains in the range of 8–45%. T1 tumours represent <10% of ampullary adenocarcinomas in Western populations. It has been proposed that local resection by EP or transduodenal ampullectomy can be curative in selected T1 adenocarcinomas; however, the case series supporting this claim are limited by small patient numbers and short follow-up periods. Pancreaticoduodenectomy remains the treatment of choice for all ampullary adenocarcinomas.

Conflicts of interest

None declared.

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Appendix 1 Search strategy: PubMed

01 Ampulla tumour
02 Ampullary tumour
03 #1 or #2 and imaging
04 #1 or #2 and computer tomography
05 #1 or #2 and magnetic resonance imaging
06 #1 or #2 and endoscopic ultrasound
07 #1 or #2 and ultrasound
08 #1 or #2 and positron emission tomography
09 #1 or #2 and laparoscopy
10 #1 or #2 and pancreaticoduodenectomy
11 #1 or #2 and endoscopic papillectomy
12 #1 or #2 and ampullectomy
13 #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #11 or #12
14 Filter: English
15 Filter: Human
16 Filter: Year 2000–current